Research Overview

Much remains to be discovered about the fundamental interactions driving RNA folding. Advances in understanding these interactions will facilitate accurate prediction of structure from sequence. To continue enjoying this quest, Doug is now a free "postdoc" in Dave Mathews' lab in the Department of Biochemistry and Biophysics at the University of Rochester Medical Center (https://rna.urmc.rochester.edu). There, Doug is learning about the latest structure prediction methods and algorithms in order to apply them to published experimental results from the Turner lab. The goal is to provide deeper insights into the experimental results and into ways to improve predictions.

Bio of Doug Turner

Before Rochester

Doug Turner grew up in Brooklyn, NY where he claims, "As a stick ball player I developed the best curve ball and screwball on my block".

Doug attended Harvard College, where he graduated cum laude in Chemistry and was commissioned as a Second Lieutenant in the U. S. Army. He did his graduate work in the Chemistry Departments of Columbia University and Brookhaven National Labs, where he worked with George Flynn and Norman Sutin to develop the Raman laser temperature jump method for measuring kinetics on a nanosecond time scale. During this period, he also spent three months in Anniston, Alabama taking the Officer's Basic Course of the Army's Chemical Corp. There he was allowed to wear a light blue T-shirt after being designated a "super jock". The Army has made bigger mistakes. Deciding that he liked science more than war, he did not apply to continue as an officer on active duty. Instead, he went to the University of California at Berkeley to postdoc with Ignacio Tinoco, Jr. There, he invented fluorescence detected circular dichroism for measuring the optical activity of the fluorescent component of a solution and rose to the rank of Captain in the Chemical Corp.

At Rochester

In 1975, Doug joined the faculty of the Chemistry Department at the University of Rochester, where he became a professor. Doug was lucky to be part of the academic family of Tom Cech (Nobel Prize in Chemistry, 1989) during 2 separate sabbatical years at the University of Colorado at Boulder. Doug has been unusually lucky with his own academic family of 9 postdocs, 50 students who graduated with Ph.D.'s, and his other collaborators. Together, they discovered many of the fundamental principles that determine RNA structure.

One insight was that hydrogen bonding contributes to the thermodynamics stabilizing RNA structures. Sequence dependent principles, occasionally dubbed RNA "Turner Rules", ^[2] are used in many RNA structure prediction algorithms. This has helped advance methods for predicting RNA structure and interactions from sequence, e.g. miRNA and siRNA target binding, and optimally folding sequences for mRNA vaccines. Methods employing the RNA "Turner Rules" are widely used by biochemists and biologists. In the Turner lab, these methods were used to discover potentially medically important RNA structures of influenza virus, including an RNA pseudoknot that may play a role regulating splicing at an Influenza A Segment 7 splice site.



Students and friends attending Doug's 60th birthday celebration.

Doug accepting the 2014 UR Graduate Teaching Award on behalf of his Ph.D. students.

Doug and collaborators also used Nuclear Magnetic Resonance and Molecular Dynamics simulations of short RNAs to test understanding of the sequence dependence of stacking and hydrogen bonding interactions.

Papers coauthored by Doug have been cited over 20,000 times. The work has also been recognized by Sloan and Guggenheim Fellowships, election as a Fellow of the American Association for the Advancement of Science (AAAS), selection by the American Chemical Society as a Gordon Hammes Lecturer, continuous funding of an NIH grant from 1976 to 2019, and coauthorship of more than 250 papers. With Ryszard Kierzek from the Institute of Bioorganic Chemistry in Poznan, he shared the AAAS Poland-US Science Award in 2016.



Doug giving the Gordon Hammes Lecture at the 2011 ACS meeting.

Doug and collaborators (Scott Kennedy, Joanna Olmsted, Ela & Ryszard Kierzek, Brent Znosko, Phil Bevilacqua) getting together at the 2011 ACS meeting.



Doug and Ryszard Kierzek at the 2016 AAAS Poland-US Science Award ceremony in Warsaw.

Doug also served the scientific community by often teaching first year undergraduate Chemistry and graduate Biophysical Chemistry courses, by being a member of several NIH Study Sections, the Advisory Board of the Institute of Bioorganic Chemistry in Poznan, and the editorial board of the Biophysical Journal. He also co-chaired a Nucleic Acids Gordon Conference.

In addition to his professional life, Doug has also been lucky in his personal life. In 1975, Joanna Olmsted joined the faculty of the Biology Department at the University of Rochester. Doug met her 6 months later at a Ph.D. defense celebration. They married in 1977, have a wonderful son, and continue to enjoy the chemistry and biology of life.



Doug and Joanna enjoying a Chemistry Department dinner.

1. Turner, D H; N Sugimoto; S M Freier (1988). "RNA Structure Prediction". Annual Review of Biophysics and Biophysical Chemistry. **17** (1): 167–192. <u>doi:10.1146/annurev.bb.17.060188.001123</u>. <u>ISSN 08839182</u>. <u>PMID 2456074</u>.

2. Turner, D. H.; Mathews, D. H. (2009). <u>"NNDB: The nearest neighbor parameter database for predicting stability of nucleic acid</u> secondary structure". Nucleic Acids Research. **38** (Database issue): D280–D282. <u>doi:10.1093/nar/gkp892</u>. <u>PMC 2808915</u>. <u>PMID</u> <u>19880381</u>.